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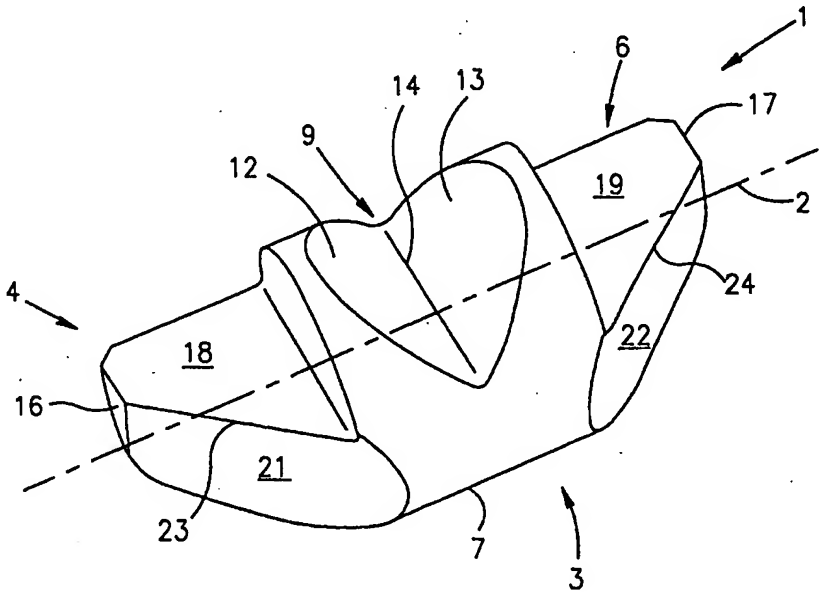

(57) Abstract

A cutting insert (1) having a longitudinal axis (2), a clamping portion (3) with at least a partial cylindrical peripheral surface (7), and at least one cutting end portion (4, 6) having an end surface (16, 17) and being narrower than the clamping portion in an end view of the cutting insert and a cutting edge (23, 24) defined at the intersection of a rake surface (18, 19) and a relief surface (21, 22) and extending from the end surface to the cylindrical peripheral surface. The clamping portion has a clamping recess (9) with at least one clamping surface (12, 13) transversely directed towards the longitudinal axis in a cross-sectional view to a plan view of the recess and passing through the longitudinal axis.

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CUTTING INSERT AND CUTTING INSERT HOLDER THEREFOR

FIELD OF THE INVENTION

This invention relates to a cutting insert and a cutting insert holder therefor.

BACKGROUND OF THE INVENTION

In US Patent 4,795,290 to Lindberg, there is illustrated and described a drill with a cutting insert for so-called secondary machining operations such as chamfering, counterboring and/or countersinking. The drill is formed with a major mainly cylindrical recess transversely disposed relative to its axis of rotation for receiving a cylindrical body portion of a cutting insert also having a longitudinal axis, an end cutting portion and a longitudinal groove co-directional with its longitudinal axis and extending along its entire length. The drill is also formed with a similarly oriented minor mainly cylindrical recess which overlaps with the major recess for receiving a clamping pin when the cutting insert's longitudinal groove is in registration with the minor recess for releasably clamping the cutting insert in the major recess. The cutting insert is released by removal of the clamping pin by means of a tool such as a pair of pliers.

The cutting insert suffers from its cutting end portion being weakened due to the provision of the longitudinal groove whilst the clamping arrangement also suffers from a number of disadvantages as follows: First, the cutting insert has to be necessarily initially accurately positioned in the major recess such that its longitudinal groove is in registration with the minor recess for insertion of the clamping pin. Second, the handling of the clamping pin is in itself rather difficult due to its shape and its small size which also lends to it being readily mislaid.

Third, the insertion of the clamping pin does not in itself positively axially urge the cutting insert against an abutment surface but rather this is achieved by a force component of cutting forces acting on the cutting insert during a cutting operation. And lastly, the removal of the clamping pin is relatively cumbersome and time consuming since its available surface area to be gripped by a tool is relatively small. Furthermore, the cutting insert and the clamping arrangement do not lend themselves to a cutting insert with a pair of lateral end portions.

SUMMARY OF THE INVENTION

In accordance with the present invention, there is provided a cutting insert having a longitudinal axis, a clamping portion with at least a partial cylindrical peripheral surface, and at least one cutting end portion having an end surface and being narrower than said clamping portion in an end view of the cutting insert and a cutting edge defined at the intersection of a rake surface and a relief surface and extending from said end surface to said cylindrical peripheral surface, said clamping portion having a clamping recess with at least one clamping surface transversely directed towards said longitudinal axis in a cross sectional view to a plan view of said recess and passing through said longitudinal axis.

A cutting insert of the present invention has a clamping surface against which a clamping element bears for simultaneously positively axially urging the cutting insert against an abutment surface and urging the cutting insert into a predetermined orientation relative to its longitudinal axis. A clamping element preferably cooperates with a cutting insert such that the former can still urge the latter into a predetermined position and orientation without the latter being initially inserted into a cutting insert receiving pocket in a near absolute predetermined manner. By virtue of the present invention, a cutting insert can preferably have a pair of lateral cutting end portions, for example, as illustrated and described in US Patent 3,599,303 to Sletten, and preferably with cutting end portions which can be simultaneously operative.

A cutting insert of the present invention can be deployed in a cutting tool implemented for either secondary machining operations only or, preferably, multi-machining operations on a workpiece up to a predetermined maximum depth of cut by virtue of a first set of one or more primary cutting inserts for stock removal from the workpiece up to the maximum depth of cut and a second set of one or more secondary cutting inserts for secondary machining operations at a depth of cut less than the maximum depth of cut. In both cases, a cutting tool can be implemented for *inter alia* milling operations, turning operations, and drilling operations.

BRIEF DESCRIPTION OF THE DRAWINGS

For a better understanding of the present invention and to show how the same can be carried out in practice, reference will now be made to the accompanying drawings, in which:

Fig. 1 is a perspective view of a cutting insert in accordance with a first embodiment of the present invention;

Fig. 2 is a plan view of the cutting insert of Figure 1;

Fig. 3 is a front view of the cutting insert of Figure 1;

Fig. 4 is an end view of the cutting insert of Figure 1;

Figs. 5-10 are perspective views of cutting inserts in accordance with additional embodiments of the present invention;

Fig. 11 is an end view of a cutting insert in accordance with a still further embodiment of the present invention;

Fig. 12 is a partial perspective view of a slotting cutter in accordance with the present invention;

Fig. 13 is a partial side view of the slotting cutter of Figure 12;

Fig. 14 is a partial cross sectional view of the slotting cutter of Figure 12 taken along line XIV-XIV in Figure 13 and showing also a machined workpiece;

Fig. 15 is an enlarged cross sectional view of a portion of the slotting cutter of Figure 12 taken along lines XV-XV in Figures 13 and 14;

Fig. 16 is a perspective view of the portion of the slotting cutter shown in Figure 13;

Fig. 17 is a partial cross sectional view of a slotting cutter similar to the slotting cutter of Figure 12 showing a cutting insert disposed so as to present a single operative cutting edge;

Fig. 18 shows a workpiece with a stepped shape profile machined by a slot cutter having three sets of different cutting inserts of the present invention at different radially disposed positions; and

Fig. 19 is a partial perspective view of a turning tool including a cutting insert of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

Turning now to Figures 1-4, a double ended cutting insert 1 of length *L* has a longitudinal axis 2 and a central clamping portion 3 interdisposed between a pair of lateral cutting end portions 4 and 6. The clamping portion 3 has a cylindrical peripheral surface 7 and a longitudinal median plane 8 passing through the longitudinal axis 2. The clamping portion 3 is formed with a symmetrical V-shaped groove 9 constituting a clamping recess bounded in the clamping portion 3 and having a plane of symmetry 11 normal to the longitudinal axis 2 (see Figure 3). The groove 9 has clamping surfaces 12 and 13 meeting at a line 14 parallel to the longitudinal median plane 8 and normal to the longitudinal axis 2.

The cutting end portions 4 and 6 have planar end surfaces 16 and 17 which are narrower than the cylindrical peripheral surface 7 in an end view of the cutting insert 1. The cutting end portions 4 and 6 also have planar rake surfaces 18 and 19, respectively, intersecting with planar relief surfaces 21 and 22, respectively, at straight cutting edges 23 and 24, respectively. The cutting

edges 23 and 24 are transversely directed to the longitudinal axis 2 in a plan view of the cutting insert 1 and terminate at first ends 23A and 24A, respectively, adjacent the peripheral cylindrical surface 7 and second ends 23B and 24B, respectively, adjacent the end surfaces 16 and 17 (see Figure 2).

Figure 5 shows a cutting insert 27 similar to the cutting insert 1 differing therefrom in that it has concave cutting edges 28. Figure 6 shows a cutting insert 29 similar to the cutting insert 1 and differing therefrom in that it has convex cutting edges 31. Figure 7 shows a cutting insert 32 similar to the cutting insert 1 and differing therefrom in that its clamping recess is constituted by a substantially conical groove 33 with an axis 34 perpendicular to the longitudinal axis 2 in a front view of the cutting insert 32. Figure 8 shows a cutting insert 36 similar to the cutting insert 1 and differing therefrom in that it is single ended with a clamping portion 3 having a partial cylindrical peripheral surface 37 in an end view of the cutting insert 36. Figure 9 shows a cutting insert 38 similar to the cutting insert 1 and differing therefrom in that it is indexable with an axis of rotation 39 normal to the longitudinal axis 2 and its cutting end portions 4 and 6 have cutting edges 41 and 42 directed in opposite senses. Figure 10 shows a cutting insert 43 similar to the cutting insert 38 and differing therefrom in that its cutting end portion 4 has cutting edges 44 and 46 and its cutting end portion 6 has cutting edges 47 and 48. The cutting insert 43 is indexable with an axis of rotation 45 normal to the longitudinal axis 2 whereby the cutting insert 43 can be used as a right or left hand insert, and whereby the cutting edge 44 is indexable with the cutting edge 48 and the cutting edge 46 is indexable with the cutting edge 47. Alternatively, the cutting edges 44 and 47 can be simultaneously operative as can the cutting edges 46 and 48. Figure 11 shows a cutting insert 49 similar to the cutting insert 1 and differing therefrom in that it has a curved cutting edge 51 defined at the intersection of a curved rake surface 52 and a curved relief surface 53.

Figures 12-16 show a double-sided slotting cutter 60 for a

multi-machining operation on a workpiece 61 for forming a groove 62 having chamfered surfaces 63 and 64 (see Figure 14). The slotting cutter 60 has a main body 65 rotatable about an axis of rotation 66 and having a hub 67, a peripheral portion 68 and an intermediate portion 69 therebetween. The hub 67 has a stepped configuration with an annular rim 71 to provide an end wall 72 of a number of cylindrical cutting insert receiving pockets 73 each having a longitudinal axis 74 parallel to the axis of rotation 66. A screw threaded through bore 76 terminates at a cutting insert receiving pocket 73. The screw threaded bore 76 receives a clamping screw 77 constituting a clamping element. A clamping screw 77 has a front end 78 for abutting against a clamping surface 13 of a cutting insert 1 for rotating same into its operative position and for urging its end face 17 against the end wall 72 for accurate positioning.

The slotting cutter 60 has conventionally mounted cutting inserts 79 (constituting primary cutting inserts) disposed on the peripheral portion 68 for machining the groove 62, and annularly disposed cutting inserts 1 (constituting secondary cutting inserts) disposed partially in the hub 67 for chamfering the groove 62 to obtain the chamfered surfaces 63 and 64. The cutting inserts 79 are disposed so as to present alternate right and left hand operative side cutting edges 81 and 82, respectively, and respective overlapping peripheral cutting edges 83 and 84 of an overall cutting length d which is less than the length L of the cutting inserts 1 so that their cutting edges 23 and 24 respectively machine chamfered surfaces 63 and 64.

While the invention has been described with respect to a limited number of embodiments, it will be appreciated that many variations, modifications and other applications of the invention can be made. For example, secondary cutting inserts do not have to be located in a slotting cutter's hub region but can be equally well located at any radial location and possibly with only a single operative cutting edge (see Figure 17). A slotting cutter can be provided with several sets of secondary cutting inserts at different radial locations, for

example, cutting inserts 1 for machining a chamfer 86, cutting inserts 29 for machining a concave step 87 and cutting inserts 27 for machining a convex step 88 (see Figure 18). Furthermore, the present invention is not limited to milling operations and can be equally applied to a turning tool 89 having a main body 91 with a longitudinal axis 92 and a cylindrical insert receiving pocket 93 with a longitudinal axis 94 perpendicular to the longitudinal axis 92 for clampingly receiving a cutting insert 1 (see Figure 19).

CLAIMS:

1. A cutting insert having a longitudinal axis, a clamping portion with at least a partial cylindrical peripheral surface, and at least one cutting end portion having an end surface and being narrower than said clamping portion in an end view of the cutting insert and a cutting edge defined at the intersection of a rake surface and a relief surface and extending from said end surface to said cylindrical peripheral surface, said clamping portion having a clamping recess with at least one clamping surface transversely directed towards said longitudinal axis in a cross sectional view to a plan view of said recess and passing through said longitudinal axis.

2. A cutting insert according to Claim 1 wherein said clamping recess is bounded in said clamping portion.

3. A cutting insert according to either Claim 1 or 2 wherein said clamping recess is a V-shaped groove.

4. A cutting insert according to Claim 3 wherein said V-shaped groove has a plane of symmetry perpendicularly directed to said longitudinal axis in a front view of the cutting insert.

5. A cutting insert according to either Claim 1 or 2 wherein said clamping recess is substantially conically shaped.

6. A cutting insert according to any one of Claims 1-5 wherein said cutting edge is curved in a plan view of the cutting insert.

7. A cutting insert according to any one of Claims 1-6 wherein said rake surface is curved in an end view of the cutting insert.

8. A cutting insert according to any one of Claims 1-7 wherein said relief surface is curved in an end view of the cutting insert.

9. A cutting insert according to any one of Claims 1-8 and having a pair of lateral cutting end portions.

10. A cutting insert according to Claim 9 wherein the cutting insert is indexable.

11. A cutting insert holder comprising a main body with at least one cylindrical insert receiving pocket for clampingly receiving a cutting insert according to any one of Claims 1-10, and a corresponding number of clamping elements each being in engagement with said main body and associated with an insert receiving pocket for bearing against said clamping surface of said cutting insert received in said insert receiving pocket.

12. A cutting insert holder according to Claim 11 wherein the holder is a milling holder having an axis of rotation and said at least one cylindrical insert receiving pocket each having a longitudinal axis parallel to said axis of rotation.

13. A cutting insert holder according to Claim 12 wherein said main body has an abutment surface against which bears an end surface of said cutting insert.

14. A cutting insert holder according to Claim 11 wherein the holder is a turning holder having a longitudinal axis and said cutting insert each having a longitudinal axis transversely directed to said longitudinal axis.